Acoustic analyses of differences in [ç] and [ʃ] productions in Hood German

Stefanie Jannedy[1], Melanie Weirich[1] & Luisa Helmeke[2]

[1]ZAS Berlin; [2]Univ. Potsdam
{jannedy; weirich}@zas.gwz-berlin.de; helmeke@uni-potsdam.de

ABSTRACT

[2] postulates that the multi-ethnolect *Hood German* (as spoken in Berlin, Ger) differentiates three realizations of /ç/: [ç], [ɕ] and [ʃ]. Earlier acoustic analyses of 1192 tokens of /ç/ from the ZAS-spontaneous speech database (collected from 9 adolescent speakers of the Hood German multi-ethnolect) [9] showed no reliable differences in curtosis, skewness, cog or peak between items impressionistically categorized into these three groups.

For a more controlled study, we have now collected 3 minimal pairs contrasting /ç/ with /ʃ/, read 1) embedded in carrier sentences and 2) as word lists. 32 adolescents from a middle school in Kreuzberg (Berlin) participated in this study. Many of them had muli-ethnic backgrounds and spoke languages other than German at home, but several students also were monolingual mono-ethnic Germans.

Results indicate that there is a strong tendency for /ç/ and /ʃ/ to merge in the speech of young Kreuzberg adolescents and that the language background (monolingual versus multilingual), has an influence on the realization of /ç/ as [ç], [ɕ] or [ʃ]. However, also monolingual mono-ethnic Germans show a strong tendency for merging and dismissing this contrast. Moreover, our data suggests that locally identifying as somebody from Kreuzberg in contrast to just Berlin is a predictor for palatalization.

Keywords: Palatal Fricative, Hood German, Cog, Skewness, Kurtosis, DCT, local identity

1. INTRODUCTION

The emergence of linguistic variation and grammatical innovations introduced by young speakers from multi-ethnic urban neighborhoods has been observed in many European cities (to name a few: Multicultural London English: [20],[14]; Straattaal (Netherlands): [1],[17]; Rinkeby-Svenska (Sweden): [15],[4]; Kobenhavnsk Multietnolekt (Denmark) [23]; Multiethnolektales Schweizerdeutsch (Switzerland): [19]). The multi-ethnic youth variety observed in Hamburg and Berlin is called Hood German (Kiezdeutsch) and predominantly spoken by multi-ethnic but also mono-- and monolingual German adolescents ([2], [3], [22]). It displays several morpho-syntactic alternations such as the omission of prepositions and articles, preposed sentence initial temporal adverbials and the frequent use of the discourse particle *so* [10] functioning much as English *like*, marking unspecificity.

Phonetic/phonological alternations include the raising and fronting of /ɔɪ/, a velar realization of /l/, tensing of final <-er>, dental release of /t/ [11] and most saliently, the realization of the palatal fricative /ç/ as [ɕ] or [ʃ] ([9], [12]). In fact, for some speakers of Hood German, the contrast between /ç/ and /ʃ/ seems completely lost. The (perceived) lack of contrast plays a rather important role in the perception of Hood German: older listeners interpret more often /ʃ/ than /ç/ on a synthesized acoustic continuum when primed with the concept of Kreuzberg (one of the multi-ethnic neighborhoods highly associated with this alternation) compared to when primed with a neighborhood name not associated with the multi-ethnic youth variety. Younger listeners did not show this effect [12].

Thus, this alternation is becoming more widely accepted with younger speaker groups [12] and possibly points to a beginning sound change in Berlin. It may also be facilitated by middle German dialects not contrasting /ç/ and /ʃ/ and spreading into the Berlin vicinity. Moreover, there is evidence that some older speakers of Berlin German do not contrast these sounds. Therefore, dialectal influence as well as variation in the ambient speech environment by Berliners and Hood German speakers, facilitate this alternation and the potential spread to a wider speech community, making this alternation a feature of a sociolect (used by a wider community) rather than a multi-ethnolect.

The goal of this paper is a systematic acoustic analysis, if and how adolescent speakers from Kreuzberg – one locus of this alternation –

realize the contrast between /ç/ and /ʃ/. Speakers from a middle school in Kreuzberg volunteered for this study. We used controlled speech data for the systematic analyses of the contrast realization. According to [16], changes in speaking styles can be induced by different speaking tasks, ranging in formality from casual to careful to read speech, word lists and minimal pairs. The assumption is, that the more attention is paid to speech, the more contrast should be realized. Thus, reading (a more formal speaking style than casually conversing) minimal pairs or minimal pairs embedded in carrier phrases should drastically enhance any (residual) acoustic contrast that speakers produce compared to iterations of such items in casual conversation.

2. METHODS

2.1. Speakers

Acoustic recordings were made from 32 adolescents (19 female, 13 male, mean age 13.9, SD 0.9) attending a middle school in the multi-ethnic district of Kreuzberg, Berlin. Recordings were made in a quiet room with a professional microphone and recording device (Taskam DR-05 linear PCM recorder and a Sennheiser directional microphone ME64). Meta-data on these students was collected, including their age, sex, ethnic background, national and local identity, their own language background, their father's and mother's ethnic and language backgrounds, language(s) spoken at home, language spoken with friends, number and age of siblings, their favourite subject in school, or what music they favoured.

2.2. Speech Material

The speech material consisted of the German minimal pairs

1. fischte /fɪʃtə/ – Fichte /fɪçtə/
   fished, 3rd p. sg. – *spruce*

2. misch /mɪʃ/ – mich /mɪç/
   mix! – *myself*

3. wischt /vɪʃt/ – Wicht /vɪçt/
   wipe, 3rd p. sg. – *gnome*

We asked participants a) to read all words from a list, and b) to read the words embedded in the carrier sentence "Ich habe ___ gesagt." (*I said ___ .*) In both conditions, the word lists and the sentences, contrasting items followed each other. Both lists were read from top to bottom, bottom to top and again from top to bottom keeping the same order of words. We aimed at three repetitions for each target word and reading condition. However, due to reading errors the number slightly varies between conditions, speakers and minimal pairs. All together 714 tokens were subjected to the analyses from both reading tasks.

2.3. Acoustic analyses

All fricatives were labelled based on the energy distribution of the spectrogram and acoustic measurements were logged at the midpoint of the sibilant. Multiple acoustic measurements were chosen to parameterize the spectra of the two fricatives ([8],[5],[13],[17]). First, the spectral moments following [5] were calculated consisting of 1) the centroid or *Center of Gravity* (COG), which is the mean frequency of the spectrum with the highest energy, 2) the *skewness* describing the energy distribution over the whole frequency range of the spectrum; and 3) the *kurtosis* which reveals the peakedness of the distribution. The spectral moments were calculated in *PRAAT* with a window length of 0.025s and a cutoff frequency of 500 Hz.

Second, *Discrete Cosine Transformation* (DCT), a method proposed by [21] was used to quantify the shape of the spectra and in particular the fricative contrast in more detail. Using DCTs has previously been found to provide an effective separation between the four fricative types in Polish [6], but also to be a reliable parameter to differentiate the very similar acoustic spectra of /ç/ and /ʃ/ in Berlin German [9]. DCT decomposes the signal into a set of half-cycle cosine waves and the resulting amplitudes of these cosine waves are the DCT coefficients. We will concentrate on three DCT coefficients, which 1) are proportional to the linear slope of the spectrum (DCT1), 2) correspond to its curvature (DCT2), and 3) describe the amplitude of the higher frequencies (DCT3). DCT transformation was applied after the spectra were converted into Bark following [7] and coefficients were estimated in MATLAB.

Since it was our aim to explore if speakers and if so to what extent, realize the phonemic contrast between /ç/ and /ʃ/, we matched the fricative tokens from the corresponding elicited minimal pairs and calculated the difference in the respective acoustic parameter(s). In this study, we are investigating the retention of the contrast as we are observing a sound change [12], specifically, a merger in progress with these two fricative categories. The larger the produced contrast between the two fricatives in the minimal pair was, the larger was the difference in the acoustic space.

3. RESULTS

3.1. Acoustic measurements

Figure 1 shows the spectral moments COG and skewness (left) and DCT1 and DCT3 coefficients (right) for all tokens and speakers, separated by the intended fricative (/ç/ black, /ʃ/ grey). In both graphs the fricatives' parameters overlap to a great extent and no clear distinction can be made between the two sound categories based on the acoustic data. For example, we expected the palatal fricative /ç/ to generally have a higher COG compared to the post-alveolar fricative /ʃ/. This, however, is not the case. As expected from both figures, none of the acoustic parameters differed significantly between the intended fricatives.

Figure 1: Skewness as a function of COG (left) and DCT3 as a function of DCT1 (right) separated by intended fricative (/ç/ black, /ʃ/ grey).
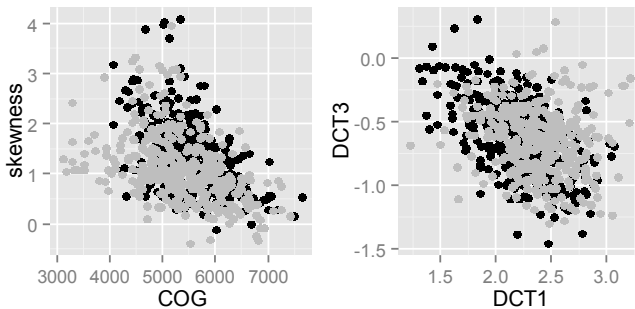
3.2. Inter-speaker variation in realizing the phoneme contrast

For a better quantification of the acoustic contrast between the fricatives, Euclidean Distances (EDs) in the DCT1 x DCT2 x DCT3 space were calculated. Figure 2 shows the distribution of the calculated EDs separated by speaker.

Figure 2: EDs (in DCT1xDCT2xDCT3 space) between the intended fricatives separated by speaker.
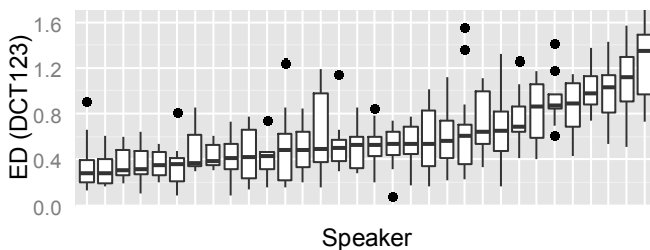

The greater the ED (higher value), the more of a contrast is produced with regard to the DCT parameter. This means that speakers displaying a small ED with regard to the DCT parameter have more or less lost the contrast between the palatal and the postalveolar fricative. In other words, the categories have merged. It is obvious that speakers vary to a great extent in the size of the acoustic distance. While for some speakers the contrast seems to be lost (as already apparent in Figure 1), some speakers still produce the fricative contrast in a measurable way.

3.3. Potential influencing factors on inter-speaker variability

To detect potential reasons for the inter-speaker variability in realizing the contrast, the EDs were analyzed with regard to their dependency on speaker background information (sex, language- and ethnic background etc.). Linear mixed models were run in R using the lme4 package and likelihood ratio tests were used to determine significant effects.

Figure 3 EDs (in DCT1xDCT2xDCT3 space) separated by multilingual (top) and monolingual (bottom) speakers.
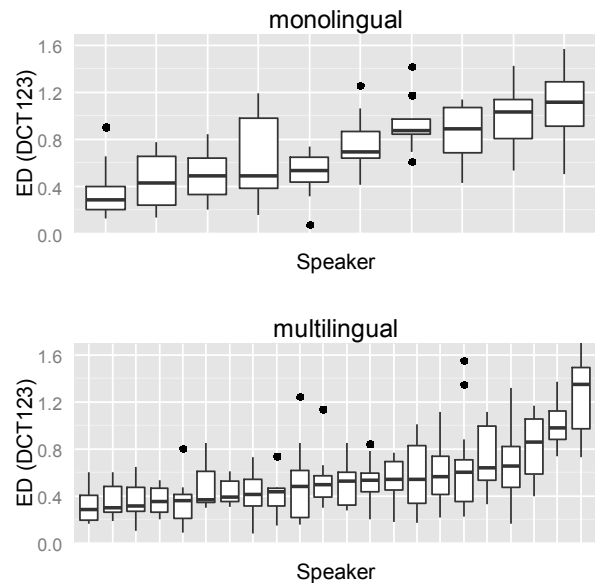
As fixed factors, we included the word pair and the elicitation condition (carrier phrase or word list) as control variables and speaker sex, monolingual vs. multilingual background, national and local identity, language of father and mother, language spoken at home, language spoken with friends as test variables. Language factors were coded as binary: German only vs. German plus at least one additional language. As random effects, we added intercepts for speaker, as well as by-speaker random slopes for the effect of word pair and elicitation condition.

A significant effect was found only for a speaker's language background as a predictor of whether or not the contrast between /ç/ and /ʃ/ is retained: overall, monolingual students reveal a

higher contrast than multilinguals ($\chi^2(1) = 4.89$, p < .05). However, as is apparent from Figure 3, both groups show a high degree of inter-speaker variability. Also some monolingual mono-ethnic German speakers only produce negligible contrasts while some multilingual speakers produce considerable and measurable acoustic distances.

From a subset of 18 speakers, we were able to collect information on their national and local identity, asking them, specifically, if they felt more like a German or more like some other nationality. We also asked whether they felt more like a Berliner or like someone from Kreuzberg. While the speaker's national identity (German versus any other nationality) did not show an effect, the speakers' self ascribed local identity (Berliner vs. Kreuzberger [the specific local neighborhood]) did.

Figure 4 EDs (in DCT1xDCT2xDCT3 space) separated by language background and local identity.
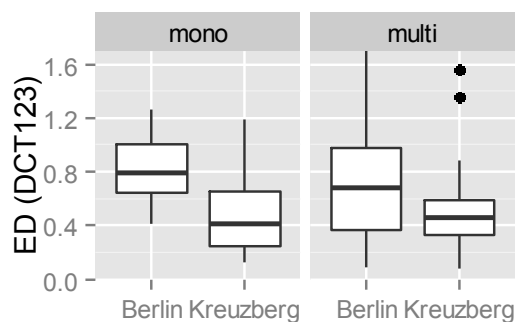

Figure 4 shows that the seven speakers identifying as Berliners (left boxes) have higher ED-values and thus produce more contrast between the fricative categories than the 11 speakers who identify specifically as Kreuzbergers (right boxes). We found a significant main effect of local identity ($\chi^2(1) = 5.79$, p = 0.016). Interestingly, for this subset, there was no effect of the speakers' language background (mono- vs. multilingual) and no interaction of the two factors (local identity and language background) pointing to a stronger effect of local identity than of the language background.

4. DISCUSSION AND OUTLOOK

It seems that some speakers have completely merged the two fricatives and have basically no awareness that the two orthographic representations that we gave them to read should render differences in the acoustics. As the Euclidian Distances show, some speakers produce differences, others do not. The aim of our elicitation method was to elicit data in a context that enhances the awareness for the contrast and that should make the purpose of the experiment clear. Our observation is that even with maximal attention paid to a contrast with different orthographic representations, some speakers are completely unaware of this contrast. We therefore believe that some of these speakers may not have ever acquired this contrast and thus are completely unaware even of different orthographic representations.

Most interesting though is that some monolingual mono-ethnic German speakers from German speaking households with no other language background also merge the two fricative categories. And they do so not only in casual unobserved speaking stiles but also when they were (implicitly) asked to produce maximal contrast. We take this (together with perceptual results that we have obtained earlier [12]) as evidence that this merged variant is becoming a more widely accepted feature of a youth style sociolect which begins to spread through a wider community in the Berlin and Brandenburg area. While we acknowledge that assessing a speaker's identity is much more complex than we can begin to describe here, we could show (with a fairly crude method), that the merging of /ç/ and /ʃ/ is strongly related to the speaker locally identifying as someone from Kreuzberg – their local neighborhood – as opposed to Berlin. From an ethnographic standpoint, much more participant observation is necessary as speakers can assume various identities in different contexts. We do however believe that our observation is correct and that a strong local affiliation with their district Kreuzberg (also expressed through signs and signifiers attached to clothing items; graffiti and signs drawn on school books, bags and pouches) gives many adolescents a sense of local identity.

We have now collected data in a small town near the urban center of Hamburg which is – just as Berlin – in a low German dialect area. Here, the two fricatives show no signs of merging, neither in adult nor adolescent speech. Acoustic analyses of these two contrasting fricatives /ç/ and /ʃ/ are being currently conducted to come to an understanding of what the differences are between canonical renditions of these fricatives and merged variants [ç], [ɕ] and [ʃ] in Berlin Hood German.

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